TESTING FLASH SYNCHRONIZATION

PHOTO EQUIPMENT TECHNICIAN COURSE

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TESTING FLASH SYNCHRONIZATION

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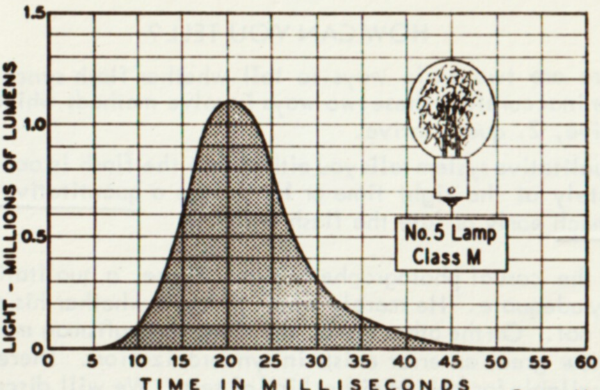
TESTING FLASH SYNCHRONIZATION

STILL OPEN - FLASH - SHUT!

If you will remember just one fact, you will have overcome one very important problem in the understanding of flash synchronization and the testing systems involved. This is the fact: Regardless of how fast either flash or shutter action occurs the entire process of flash synchronization depends entirely on the timing of these two activities. In order to get a good flash picture; one in which a maximum amount of light passes to the film, producing an image, the shutter must first open, the flash must then occur; and the shutter must close last.



Courtesy National Carbon Co.

Look at the graph which represents the flashing of an ordinary flash bulb (class "M") and it is immediately clear that the flash bulb does not provide all of its light at any given instant, but rather builds up in intensity until a brightest point or "peak" is reached and then tapers off in intensity at a comparatively slow rate. The entire action of this ordinary flash bulb, as you remember, may involve as much time as 40 to 60 milliseconds. Regardless of the method used to time the flash bulb and the shutter and regardless of the amount of the flash that is used to make the exposure, you must think in terms of the portion of the flash which occurs after the shutter opens and before it closes in order to understand flash synchronization properly.

SYNCHRONIZE THEM - TROUBLE

What is meant by synchronization? Synchronization is the timing of two or more motions or actions so that there is a definite time or motion relationship between the actions being considered. In the last lesson, you learned something of the different types of flash bulbs and how the shutter action must be related to flash bulb action in order to obtain good synchronization.

Since the flashing of a bulb and the operation of a shutter takes such a small amount of time, your eye cannot detect small variations in timing that occur during flash synchronization. Depending on the type of flash being used, the shutter must be either:

1. Opened before firing the flash.
2. Opened just as the flash is being fired.
3. Opened a comparatively long time after the flash has been fired.

Simply understanding the principles of flash synchronization, as described earlier, is enough to tell you what the proper relationship between flash firing and shutter operation should be. The method of synchronization varies but in almost any case is rather simple and straight forward. The problem is, "How can you tell whether accurate synchronization exists?"

HOW CAN YOU TELL?

There are two basic ways to tell whether flash synchronization is accurate or inaccurate. These two ways involve methods which are either: 1. qualitative, 2. quantitative.

A qualitative system tells you either that the flash is occuring early, approximately at the right time or late, while a quantitative system tells you how much early or late the flash is firing.

For the casual photographer's personal use, a qualitative system is completely adequate. He merely wants to know whether his equipment is working or not. On the other hand, the Camera Craftsman must know how much or how great an error exists in synchronization. There are several methods available for making either kind of test. We will discuss a number of these and, you will find that you can devise a number of other methods on your own, using similar principles.

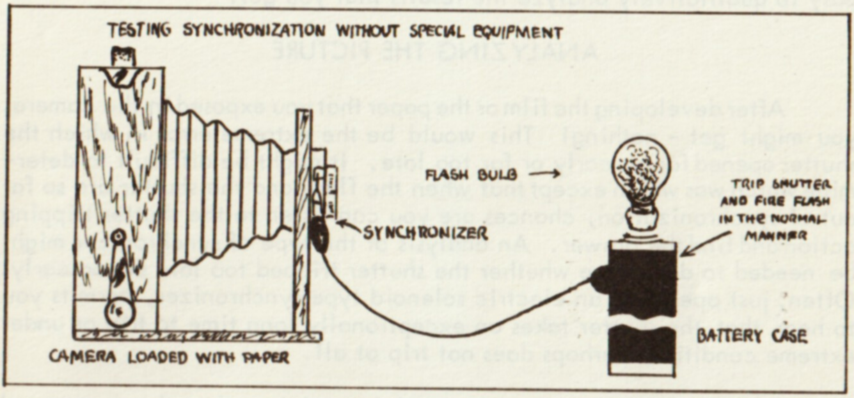
One other factor is involved which is not at first obvious. When the individual photographer wishes to test his equipment or when only occasional tests are to be made, the time and the expense of making a test are relatively unimportant. However, when you, as a camera craftsman, make many tests daily or weekly, it is imperative that the testing method you choose be quick and inexpensive. Although it is possible to make tests with virtually no equipment or with easily built home-made equipment, it does not take many tests to reveal to you that an apparently high initial investment in testing equipment quickly pays for itself.

Many of the tests that will be first described to you make use of a flash bulb as part of the test equipment. This means that, where a single test is all that is necessary, one flash bulb, costing ten to twenty cents, is all that is required for completing the test. On the other hand, as a Camera Craftsman, you should be in a position to tell your customer that his equipment will behave consistently for exposure after exposure. Were you to use flash bulbs in a series of tests to determine consistency of flash synchronization, the cost per series could range into a matter of dollars. Similarly, when adjusting a synchronizer for accuracy, you might make 15 to 20 or more tests before you would be satisfied that synchronization was perfect. Were you to apply any system using flash bulbs for this sort of testing, the cost of adjustment could rise astronomically. For these and other reasons which you will discover as you proceed, you will very likely

decide that the finest test equipment available is actually the least costly for you.

THE BULB IN THE MIRROR!

You know that when a flash bulb fires it first starts to burn immediately around the filament-lead-in wire where ignition takes place. It can be shown further that as the filler material in the flash bulb continues to ignite, a point is reached where all of the material in the flash bulb is burning at once. As more time passes the filler material which began to burn first becomes exhausted and goes out. Further time elapsing permits more of the filler material to burn out until finally no more material is available to burn and the flash bulb can produce no more light. Even though this entire action takes place in a very short time, you can find out exactly how well the bulb is synchronized with the shutter, simply by taking a picture of the bulb as it is being fired! The technique is simple.



The camera, synchronizer, battery case, flash bulb and all necessary connecting cords are set up in the normal manner. If the synchronizer is of the type which permits removing the battery case and flash bulb from the camera itself, you simply hold the bulb in front of the camera, focus carefully on the bulb, and then take a picture using the synchronizer to fire the bulb and operate the shutter. Naturally, because of the tremendous amount of light, it is necessary to close the lens diaphram to as small an aperture as is possible. For the same reason you will find it desirable to use a piece of photographic paper rather than film in the camera.

If the flashgun is of a type which does not permit removing the flash bulb from the camera in order to make its picture, you need only point the camera at a mirror so that you can photograph the reflection of the bulb as it fires. In either case it is essential that you cut down the exposure as far as you can through a combination of diaphragm aperture, shutter speed, and film speed. It is also essential that you focus very carefully on the bulb, or on its reflection in the mirror, so that a sharp image of the bulb will be obtained. Actually, the closer to the lens that the bulb is, the larger its image will be and the more easily you can interpret your results.

What happens? Using the short shutter speed, perhaps the shortest available on the camera, you will photograph only a portion of the burning cycle of the bulb. While the shutter is closed, even though the bulb may be burning brilliantly, no image will be recorded on the film. If the shutter happens to be operating accurately at, let us say 1/200th second, only a 5 to 7 or 8 millisecond period of the burning cycle of the bulb will be recorded. Careful analyses of the resulting picture can tell you whether the shutter opened at the time that the bulb started to burn, at the time the bulb was burning most brilliantly, or at the time that the bulb had began burning out.

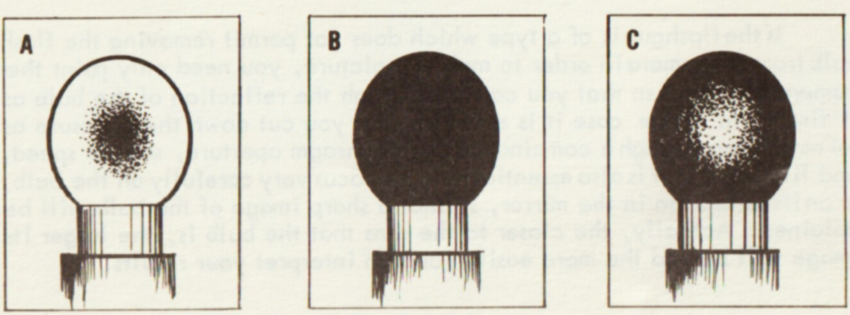
Of course, a single test of this type requires not only a flash bulb but also either film or paper plus the time required to develop the photosensitive material used in the camera. This is perfectly satisfactory when occasional tests are to be made and, as you will soon see, it is relatively easy to qualitatively analyze the results that you get.

ANALYZING THE PICTURE

After developing the film or the paper that you exposed in the camera, you might get - nothing! This would be the extreme error in which the shutter opened far too early or far too late. It might be difficult to determine which was which except that when the flash and the shutter are so far out of synchronization, chances are you can listen to the shutter tripping action and find the answer. An analysis of the type of synchronizer might be needed to determine whether the shutter tripped too late or too early. Often, just operating an electric solenoid type synchronizer, permits you to hear that the shutter takes an exceptionally long time to trip or under extreme conditions perhaps does not trip at all.

Observation, then, is a means of determining when the shutter and flash are approximately within synchronization range.

If the synchronizer is working fairly well, you should get a picture that can be analyzed. If the exposure is right, the image of the flash bulb should not be exceptionally dark. An over-exposed image is misleading for you might judge that the flash bulb was quite bright when it actually wasn't. The image that you observe should resemble one of the three illustrations shown here.



Notice that in figure "A" the center of the bulb (around the filament) is dark while the remainder of the bulb is not. This indicates that the flash bulb had just started to fire and the contents were burning only around the filament. Figure "B" illustrates the point at which the entire contents of the flash bulb are burning and is a good indication that the shutter opened during the time that the bulb was burning at a peak of illumination. Illustration "C" shows the outer edge of the flash bulb darker than the center, indicating that the filler around the filament had already burned out and that the bulb had passed its peak of intensity.

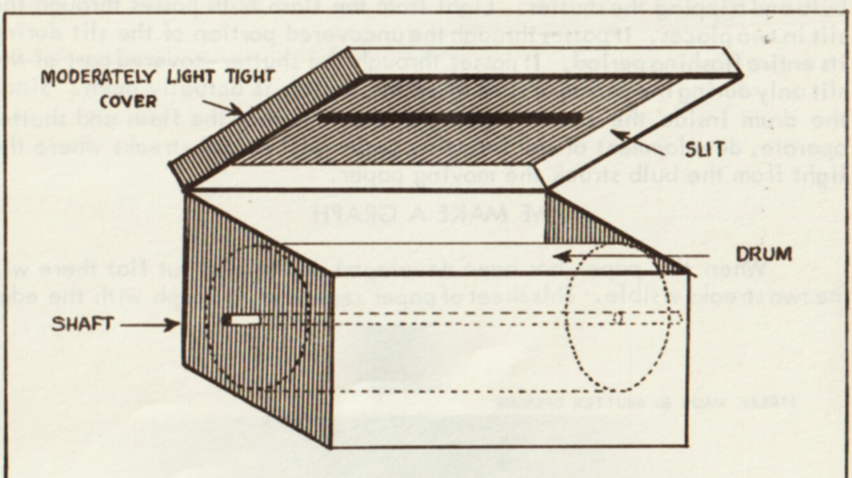
Thus, if your result is like "A", the shutter should be tripped later. If the resulting image is like "B", the synchronizer is in good adjustment. If the picture you get is like "C", the tripping action of the shutter should be speeded up.

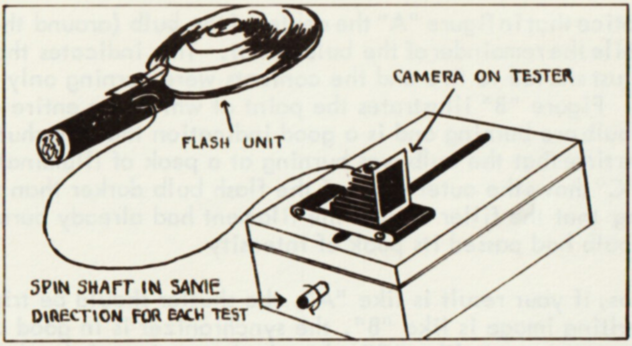
How much too slow or too fast is difficult to estimate from these pictures. A trial and error method of adjusting the synchronizer and retesting is often the only way in which the adjustment can be made. The only problem here is that a new test is expensive both in time and materials when a test must be made after each adjustment in order to determine whether the adjustment is satisfactory.

The big advantage of this testing system is that it can be done at almost any place and time without any special equipment and using only those supplies and materials already available to the photographer. If it is absolutely necessary, an adjustment can be made using this system to correctly synchronize the flash bulb and the shutter.

BUILDING AN ACCURATE SYNCHRONIZER TESTER:

With very little effort you may build a very simple "gadget" that will enable you to check the synchronization of a unit with moderate accuracy. The device is illustrated in the accompanying pictures. It consists of a box





with a removable or hinged cover having a slit in it. Inside the box is mounted a drum. This drum may be made of a tin can or mailing tube fastened securely to a wood dowel or metal rod as an axle. The ends of the axle pass through "bearing" holes in the walls of the box so that the drum may be spun within the box by turning the shaft from the outside.

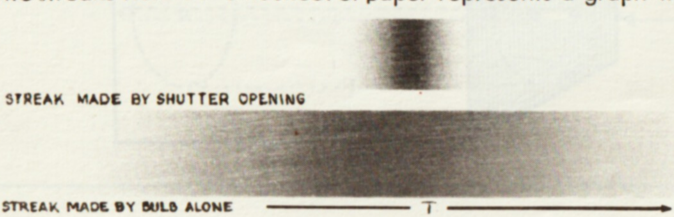
The axis of the drum is aligned with the slit in the cover. The drum should be mounted so that its surface passes close to the slit in the cover of the box.

In a darkroom you may open the cover of the box, wrap a piece of sensitized paper (perhaps contact printing paper) around the drum and hold it in place with a couple of rubber bands. Using sensitized paper, the device may be used in a darkroom under a proper safe light. The set-up of camera and flashgun are then made as shown in the accompanying picture.

The shutter is placed on top of the box so that it covers a portion of the slit. Connect the shutter to the flash bulb and synchronizer in the normal way. With the flash bulb held above the test box, the drum is spun with one hand by twisting the shaft protruding from the side of the box. While the drum is turning, the synchronizer is operated, firing the flash bulb and tripping the shutter. Light from the flash bulb passes through the slit in two places. It passes through the uncovered portion of the slit during its entire flashing period. It passes through the shutter-covered part of the slit only during the period of time when the shutter is actually open. Since the drum inside the box is turning at the time that the flash and shutter operate, development of the sensitive paper will reveal streaks where the light from the bulb struck the moving paper.

WE MAKE A GRAPH

When the paper has been developed and spread out flat there will be two streaks visible. This sheet of paper represents a graph with the edge



marked "T" in the illustration representing "Time". If the drum was spun in the direction indicated and the graph laid out so that the long streak is toward you then the passage of time is represented by the arrow marked "T".

Since you had no control over the relationship between the spinning of the drum and the flashing of the bulb, the streaks on the exposed paper may fall anywhere as shown in the accompanying pictures. Regardless of the position in which they fall the time relationships between the two streaks will still hold true.

The position of the short streak (made when the shutter opened) in relation with the long streak (made by the flash bulb firing) will tell you whether the flash peak occured early or late relative to the opening of the shutter. Notice that the long streak has greater density midway along its length. It is blackest where the bulb was brightest and this indicates the peak of the flash. If the shutter-opening streak is in line with the blackest portion of the flash-bulb's streak the synchronizer is properly adjusted. If the short (shutter) streak is to the left of the peak of the bulb, the shutter opened early and vice-versa.

Here you have a more quantitative means of judging accurate synchronization. If the drum is motor operated at a known speed you could easily calculate how much time is involved during any phase of the flashing, synchronization, or shutter operation.

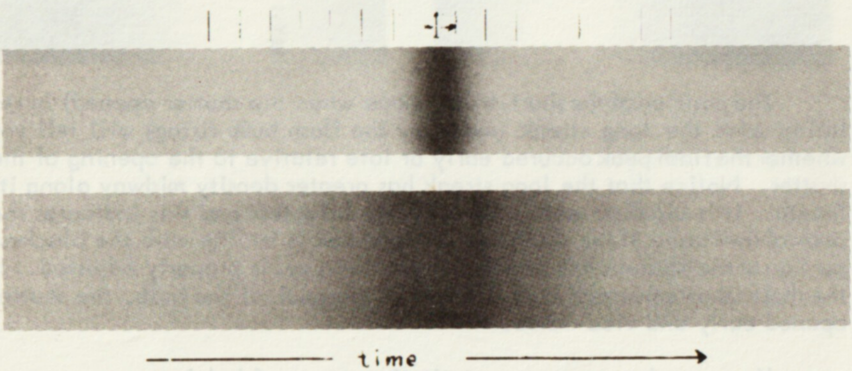
Unfortunately, a flash bulb, photo-sensitive materio' 'me are still involved in making a test using such a device. It is less, a fairly accurate way of judging synchronization and become. . useful when infrequent tests are made.

The process can be speeded up considerably and even taken out of the dark room, easily. This is accomplished simply by painting the surface of the drum with a phosphorescent paint. After being exposed to the light of a flash bulb such a surface will glow for a few minutes. The test need then only be carried out in a darkened room in exactly the same manner as before. Instead of removing a sheet of printing paper and developing it, you need only open the box and observe the glowing portions of the drum where they have been activated by the light from the flash bulb. The same means of analysis are used and after some time has elapsed the glow will fade and a new test may be made.

If a motor can be attached to the drum to drive it at a rate of 1200 rpm, the time per revolution would be .050 seconds, or 50 milliseconds. A drum with a diameter of approximately 3.18 inches or 3 and 3/16 inches would then provide you with a graph on which each inch would equal 5 milliseconds. You could work out the surface speed that would make real time analysis possible, with almost any fixed speed and drum diameter.

ANALYZING THE GRAPH

You can discover a great many things by observing the chart provided by such a device. You can find out how long it takes for the shutter to open or close because you are really expanding the action of both the shutter and the flash bulb. Thus you can read about an activity that takes place in a very short period of time on a piece of paper which replaces time by distance. Here is a chart, for example, which would be obtained from a



H = 1" = 5 milliseconds

good shutter operating at 1/200th of a second in accurate synchronization with the flash bulb. The drum is motor driven so that it turns one surface inch per 5 milliseconds. It is possible to estimate within a millisecond or so how much time it took for the shutter to open; how long the shutter remained open; and how long a period was involved during the closing of the shutter blades.

You can quickly approximate how much time was involved either before or after the flash bulb reached its peak for the shutter to completely open. Very little experience would be required to adjust the synchronizer in order to bring the two events into accurate timing.

USING YOUR SYNCHRONIZER TESTER

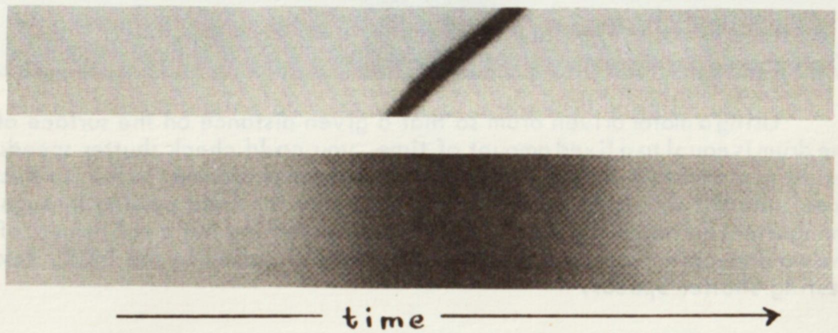
In order to get maximum value from the results, it is best to set up your tester and the equipment to be tested in certain specific ways. You should position the shutter as close to the slit as possible. This will permit easier analysis of shutter opening and closing. You should hold the bulb in such a way that the light passes with equal ease through the shutter

and that part of the slit that is unobstructed by the shutter. It is usually sufficient to hold the flash bulb 2 to 3 feet away from the tester. The large amount of light from the flash bulb will make exposure of the sensitive material or the phosphorescent surface easy.

The faster the drum turns, the longer the streaks will be and the more accurate your analysis can be.

The narrower the slit is, the better the graph that will be produced.

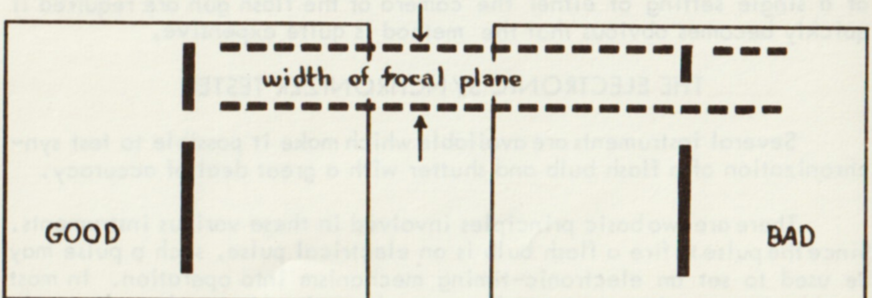
Using this system, you can test any type of flash bulb or flash unit. It makes no difference whether it is a class "M", class "F" or electronic flash. Even a focal-plane shutter can be checked with any bulb if you place the camera so that the shutter moves in a direction parallel to the length of the slit in the tester cover.



Here for example, is an illustration of a chart that you would obtain using a typical FP type bulb and a small focal-plane shutter.

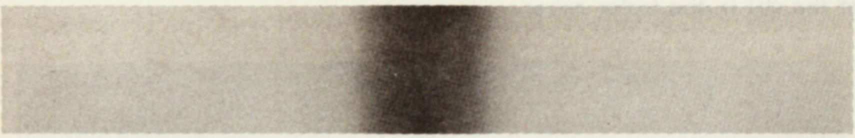
The camera was set at a fairly high speed and, as the shutter slit passed across the focal plane, light passed through to expose a diagonal line indicating the exposure over the entire focal plane area.

Here are the charts obtained with good and bad synchronization using an electronic flash unit and a small focal plane shutter.



TESTING ELECTRIC FLASH SYNCH WITH DRUM TESTER

Notice that the length of the line exposed through the focal plane shutter should be equal to the length of the focal plane aperture. If this line is short, it indicates that the shutter curtain was not completely open at the time that the electronic flash fired. Here is another example of a picture obtained using a class "F" bulb with a focal plane shutter set on a slow shutter speed.



Using a motor driven drum so that a given distance on the surface of the drum is equal to a fixed amount of time, you could check shutter speeds by using a constant-intensity light rather than a photoflash bulb. In this case, the slit should be masked off so that only the light passing through the shutter can reach the drum. This is really nothing but a refinement of the moving-object shutter test system which was discussed in the NCRS text Testing Shutter Speeds.

ONE BULB - ONE TEST

Despite the refinements that you may add to this type of shutter and synchronization test device, the unit is still relatively complicated to use, time consuming, and quite expensive per test. Each synchronization test requires at least one flash bulb. It may also require sensitive paper plus the time to process such material. Even if a phosphorescent drum is used, time is involved in analyzing the results and waiting for the drum to lose enough of its phosphorescence to make a new test. When repeated tests at a single setting of either the camera or the flash gun are required it quickly becomes obvious that the method is quite expensive.

THE ELECTRONIC SYNCHRONIZER TESTER

Several instruments are available which make it possible to test synchronization of a flash bulb and shutter with a great deal of accuracy.

There are two basic principles involved in these various instruments. Since the pulse to fire a flash bulb is an electrical pulse, such a pulse may be used to set an electronic-timing mechanism into operation. In most synchronizer-test instruments, after a pre-determined interval an electronic flash tube, similar to the one used in electronic flash units, fires. Because this tube produces a rather intense amount of light lasting for only a very

short amount of time (perhaps 1/10,000th of a second) the light has a stroboscopic effect which freezes the motion of anything which it illuminates. Thus, if such a light flashes on a shutter, while the shutter is operating, it is comparatively easy for the observer to determine whether the leaves are open or shut at the time that the flash occurs. Certainly if the light is permitted to pass through the shutter, mere appearance of the light is proof that the blades are open. Because the duration of the flash is so short, blades only partially open at the time that the flash occurs, appear

arrested in their movement at that partially open position. On some occasions it is difficult to observe but with a minimum amount of experience, the operator can see the position of the blades when the flash occurs.

By varying the time interval between the "triggering" of the firing cycle and the actual flashing of the stroboscopic tube in the flash synchronizer tester, it is possible to imitate the action of virtually any type of flash bulb. For example, if the interval of time is 20 milliseconds, the instrument flash will occur at a point equal to the instant that the peak of a class "M" flash bulb occurs. If the interval is, on the other hand, changed to 5 milliseconds, the electronic flash-synchronizer testing instrument will equal a class "F" flash bulb. With 0 time delay set on such an instrument, its operation will be that of an electronic flash unit.

Thus, in effect, this type of electronic flash synchronizer testing instrument can be set to equal any type of flash bulb with the advantage that the peak of the bulb is imitated by one very brief burst of light.

Theoretically, all that is required for a satisfactory test is that the shutter be open at the time that the peak occurs. For complete information and accurate synchronization more data than this is necessary, however.

In order to evaluate the adjustment of a synchronizer it is essential that the operator know not only that the shutter is open at the time of the peak but how much of the entire flash lamp output can be utilized by the rapidly operating shutter.

For this reason, good synchronizer test instruments provide a means of changing the flash delay by small amounts so that the position of the shutter blades at any time after the start of the flash cycle can be known.

TESTING FLASH SYNCHRONIZATION

With a stroboscopic type test instrument it is possible to manually or mentally plot the complete action of the shutter relative to time. If a series of tests are made , using a typical shutter and synchronizer set-up, the following data might be gathered;

1. After the initiation of the flash current and for 15 milliseconds afterwards, the shutter remains closed.

2. After 16 milliseconds have passed, the shutter starts to open.

3. After 17 milliseconds have passed, the shutter has opened halfway.

4. After 19 milliseconds have elapsed, the shutter is completely open.

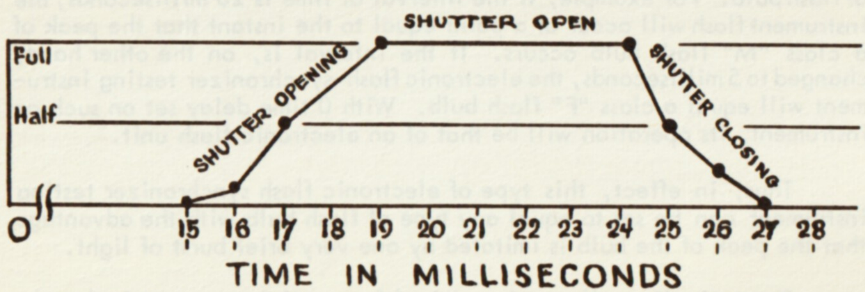
5. After 24 milliseconds have passed, the shutter is still completely open.

6. After 25 milliseconds have elapsed, the shutter is half closed.

7. After 26 milliseconds have passed, the shutter is almost completely closed.

8. After 27 milliseconds have elapsed, the shutter is completely closed once again.

These facts may be plotted on a graph like this:



This graph then shows the time required for all the phases of synchronization and shutter operation. Such a graph may be then compared with a flash bulb "time-light graph" in order to determine how well the synchronization of flash bulb firing and shutter operation has been accomplished.

Knowing the characteristics of a flash bulb, you can do a great deal of this mentally.

Certainly, after determining when the shutter opens and closes, and knowing the flashing characteristics of a bulb, you can immediately classify the synchronization as good, bad or excellent.

In the case of an electrically-operated synchronizer, such as a solenoid type, one very important error can creep in. Since the power needed to operate the solenoid tripper is so great, the addition of a flash bulb and its subsequent drain to the system may slow down the solenoid action from one to three milliseconds and materially effect synchronization. For this reason, certain synchronizer testing instruments employ a simulated flashbulb load in the circuit in order to minimize, or eliminate, this error. Of course, the addition of more than one flash bulb can cause further drift in synchronization accuracy. A few synchronization test instruments make it possible to test synchronization with an equivalent load of two flash bulbs being operated.

After having plotted the graph, as described above, another interesting analysis can be made. Knowing the opening time of the shutter, the amount of time that the shutter remains open and the closing time of the shutter, it is possible to calculate the true exposure given as the shutter opens and closes. Using virtually any stroboscopic type electronic flash synchronization tester, having a delay variable from 0 to 50 milliseconds, or more, you can thus test shutter speeds faster than 1/50th of a second. Longer shutter speeds can only be measured if there is enough delay built into the particular instrument being used.

Two factors must be considered in calculating shutter speed. The first is that a certain amount of delay is imposed by the synchronizer and all the shutter operating times involved must be calculated taking this delay into account. The second factor is that opening and closing times must be considered. At shorter exposure intervals, most shutters, whether between-the-lens or focal plane, are far from efficient, and the opening and closing times provide only partial exposure to the film. As the exposure times increase, efficiency approaches 100% and enters into shutter speed accuracy to a lesser degree. There are several mechanical ways to calculate true exposure with various instruments.

Since most shutters require identical, or almost identical, times to either open or close, the total time from the instant that the shutter starts to open until it starts to close will automatically compensate for the loss of exposure during opening and closing. The true formula for calculating full exposure is as follows: Total exposure equals opening time divided by two plus open time plus closing time divided by two, or

$$\bullet \quad E_T = \frac{OT}{2} + O + \frac{CT}{2} \quad \bullet$$

Thus, another calculating method would be to measure the time interval between the point where the shutter is half open until the shutter is half closed. Only if opening and closing times are radically different should it be necessary to make use of such a system.

TESTING FLASH SYNCHRONIZATION

When testing shutter speed with a synch tester, you must actually or mentally subtract the time required for the synchronizer to trip the shutter. In effect, the shutter does nothing (in the example described above) for some 16 milliseconds.

The Gardner Synchrotimer is one electronic testing device which has a method of eliminating subtraction due to synchronizer delay times. The Synchrotimer provides a beam of light which is interupted by the closed shutter. With proper placement of the shutter, the light can flash on a photo cell to trigger the instrument as the blades begin to open. Once triggered, the flash tube in the Synchrotimer can be fired at any interval from 0 to 1,250 milliseconds, depending on the setting of the delay dial. Using this instrument you can calculate the various shutter actions by changing the delay time and observing the position of the shutter when the stroboscopic flash illuminates it.

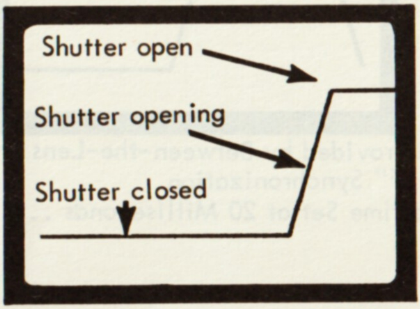
The true exposure provided by the shutter is then easily calculated mentally. Either the total period from half open to half closed may be measured or the the period from initial opening to start of closure may be measured.

THE SERVISHOP MOTION ANALYZER

In order to provide direct reading and easy interpretation of both synchronization and shutter speed as well as other actions, the ServiShop Analyzer has been developed. This instrument provides interval timing with a range from .0001 seconds or less, to 9.99 seconds or more using a completely different approach. Since a graph is so easily interpreted, the Analyzer utilizes an oscilloscope principle so that the operator is provided with an actual illuminated graph on the screen of the instrument, showing any one or several of the actions he wishes to observe.

The limiting factor in a stroboscopic type instrument is that only one instant of any action is visible at once. In the Analyzer, the entire action of the shutter and/or synchronizer, or any other device being checked, can be seen at once.

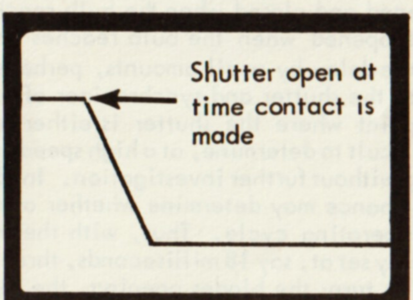
Upon triggering the Analyzer, either by operating a flash gun, closing contacts or any one of several other methods, a spot of light starts to travel across the screen. If a shutter, or synchronizer or similar device is to be analyzed, light is permitted to pass through the shutter as it opens. The light falls on a photo cell through an optical system. The spot on the screen then rises or falls to show the opening and closing of the shutter relative to time. Since the time required for the spot to move across the screen can be changed very precisely, it is possible to provide a graph showing virtually any action, plotted against time. For example, with the "sweep" time (time required for the spot to travel across the screen) on the Analyzer set at 20 milliseconds, operating a synchronizer with a shutter in good adjustment would provide a picture like this;



Synch test: Sweep time Set at 20 Milliseconds...

This graph illustrates that the shutter starts to open before 20 milliseconds has elapsed and is wide open at the time that the flash bulb reaches its peak. Without changing the sweep time (which was set at 20 milliseconds) it is possible to check for synchronization with an electronic flash unit or class "F" bulbs.

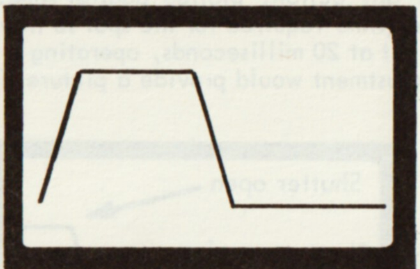
Here, for example, is the picture provided by the Analyzer when a shutter is properly synchronized for "X" synchronizer or electronic flash units.



Graph Provided by Between-the-lens Shutter
with Good "X" Synch.
Sweep time Set at 20 Milliseconds .....

TESTING FLASH SYNCHRONIZATION

This illustrates that at the time flash contact was made, the shutter was already wide open. It remained open for a short time thereafter and closed. Here is another example, showing the appearance on the Analyzer screen of a shutter properly synchronized for class "F" bulbs.

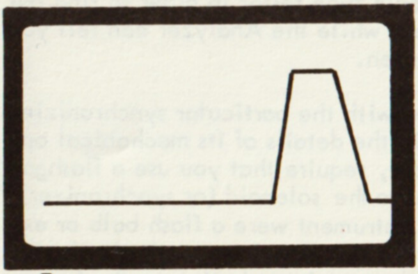


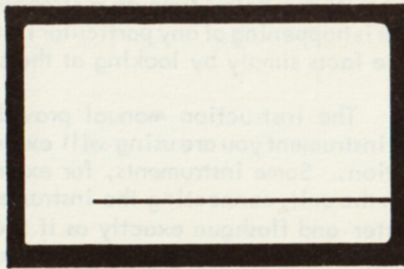
Graph Provided by Between-the-Lens Shutter with Good "F" Synchronization
Sweep time Set at 20 Milliseconds ......

This picture illustrates that at the time the flash contact was made the shutter was still closed but immediately began to open so that the flash "peak" and fully-open shutter occur simultaneously.

As you can see, the big advantage of the Analyzer is that you can see the entire shutter action simultaneously. Although one of the simplest tests to be made on the Analyzer is flash synchronization, it is interesting to compare this application of the Analyzer with a stroboscopic type instrument. Suppose, for example, that, with the shutter set at a high speed, the synchronizer under test is slightly out of adjustment. With a stroboscopic type testing instrument you would quickly see that the shutter is not open at 20 milliseconds. The question would remain, however, "Has the shutter already opened and closed when the bulb reaches its peak, or has the shutter not yet opened when the bulb reaches its peak?" It is then necessary to adjust the delay by small amounts, perhaps one millisecond at a time, and operate the shutter and synchronizer after each change until you "pick-up" a point where the shutter is either opening, closing, or fully open. It is difficult to determine, at a high speed, whether the shutter is opening or closing without further investigation. In addition, if the shutter is erratic, mere chance may determine whether or not you will see the shutter during its operating cycle. Thus, with the shutter operating erratically and the delay set at, say 18 milliseconds, three successive tripping cycles may reveal, in turn; the blades opening, the blades closed and the blades closing.

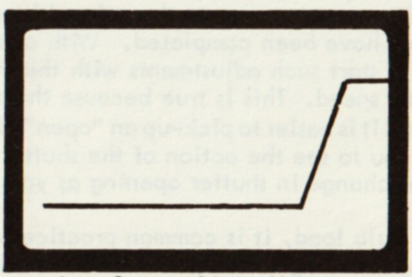
If under the same circumstances the Analyzer is used to make the test only one of two indications are possible:





A Sweep time Set at 20 Milliseconds ...... **B**

If the graph "A" is plotted it is quickly apparent that the shutter has already opened and closed when 20 milliseconds have elapsed. If, on the other hand, the graph "B" is plotted it is obvious that the shutter has not yet opened after 20 milliseconds has elapsed. Several trippings of the shutter will quickly reveal if the shutter is operating the same way each time it cycles. This is true because a shift in the graph is plainly evident on the Analyzer screen. In order to adjust the synchronizer for class "M" bulbs, it is completely unnecessary to change the sweep time of the Analyzer. With the sweep time remaining at 20 milliseconds, it is only necessary to adjust the synchronizer until the graph presented is exactly what you wish, probably this:



Sweep time Set at 20 Milliseconds ......

If it was first determined that the shutter was opening late, it is easy to increase the sweep time of the Anaiyzer and determine exactly when the shutter is opening. Such a step is, of course, not essential, since you need only shorten the synchronizer delay until the perfect picture is obtained with 20 millisecond "sweep".

USE OF THE FLASH GUN TESTER

Regardless of the synchronizer tester being used, the technique for adjusting synchronization remains relatively uniform. For the following dis-

cussion we will use the Analyzer's basic technique since it is, by far, the easiest. The only difference that you will have to remember is that you must shift the delay time on a stroboscopic type tester in order to find out what is happening at any particular instant while the Analyzer can tell you these facts simply by looking at the screen.

The instruction manual provided with the particular synchronizing test instrument you are using will explain the details of its mechanical operation. Some instruments, for example, require that you use a flashgun with the unit; connecting the instrument to the solenoid (or synchronizer), shutter and flashgun exactly as if the instrument were a flash bulb or extension flash unit. Others, like the Gardner Synchrotimer, or the Analyzer, permit you to operate a solenoid simply by pressing a button on the instrument. In such case, the instrument acts as a battery case plus the flash bulb. If a mechanical synchronizer is used or contacts are present in the shutter internal synch-section, the better synchronizer test instruments permit you to eliminate the use of a battery case. Simply closing the contacts to complete a circuit will trigger the instrument.

With the Analyzer, it is also possible to check the flash contacts themselves. Thus, you can determine how well the contacts close and how long they remain closed. This function of the Analyzer is completely seperate from its use for testing flash synchronization and is just another indication of the versatility built into it. Such flash contacts are, of course, very important, since they are only capable of firing a flash bulb or operating a flash unit if they close efficiently for a minimum amount of time.

It is customary in adjusting a synchronizer of the solenoid type, to first adjust it without any extra load placed on the batteries. This is wise since it may be necessary to operate the solenoid many times before the first rough adjustments have been completed. With a stroboscopic type instrument, it is wise to start such adjustments with the shutter set on a comparitively slow shutter speed. This is true because the shutter remains open for a longer period and it is easier to pick-up an "open" time. The Analyzer, of course, permits you to see the action of the shutter even at the highest speed and observe the change in shutter opening as you adjust the solenoid.

With no flash bulb load, it is common practice to adjust the synchronizer so that the shutter begins to open about 15 milliseconds after firing the bulb. When the adjustment is fairly close, the next test should be made with a flash bulb load included in the circuit. If you are not using an instrument of the type that permits the insertion of such a load automatically, you should insert either a PT1 or PT2 flash-check bulb into the bulb socket and observe the difference in synchronization. Ideal synchronization at the high speed of most shutters is obtained when, with a flash bulb load on the batteries, the shutter has just begun to close or is about to start closing after 20 milliseconds have elapsed.

With such an adjustment made, the shutter is likely to be in good synchronization at other shutter speeds as well. This is true since at slow shutter speeds the shutter may take slightly more time to open and, of course,

will remain open longer. Following this technique of precise adjustment, you can be assured of good synchronization whether the shutter has a high speed spring for the fastest exposure or not.

If the user of the camera has announced his intention of operating the synchronizer with a particular type of bulb and/or at a particular shutter speed, you should consult the time-light graph for that particular bulb and adjust the synchronizer so that the shutter is wide open at the chosen speed through the peak period of the bulb. Thus, if the user intends to use class "M" bulbs, perhaps No. 11's, at 1/100 second shutter speed, you might find it desirable to adjust the synchronizer so that the shutter is wide open at about 15 milliseconds in order to get the maximum amount of light through the shutter during the period from 15 to 25 milliseconds after the flash circuit closed.

REPORTING THE RESULTS OF THE TEST TO THE CUSTOMER

At least as important as knowing how to use your testing equipment is knowing how to tell your customer about the results of your test. It is important that you know how your customer uses his camera and flash equipment.

Since it is virtually impossible to provide perfect flash synchronization under any conditions, you should confide in your customer and tell him how to make the best use of his equipment. You should certainly adjust a synchronizer in such a way that the customer's method of use will be suited to your adjustment.

It is wise to prepare a simple chart, or at least a written report, telling your customer how synchronization is adjusted at the various speeds. Warn him about the pitfalls into which he may fall. Fox example, use your knowledge of the various malfunctions that could occur so that he can avoid trouble.

THE IMPORTANCE OF FRESH BATTERIES

Of all the malfunctions that can take place in flash equipment, probably none is more common than poor or defective batteries. The common rule is an ideal one but it involves constant testing of the batteries. Your customer should make sure that his batteries are in good condition at all times. This sounds simple and easy to accomplish but is, in fact, more difficult to carry out than one might imagine. Instilling within your customer a ration of common sense is even better insurance against lost pictures due to battery failure. It is conceiveable that batteries that test "good" may fail when in actual use.

It is wise to develop habits in your customer in addition to the mere testing of his batteries. To use a set of batteries for more than either two hundred exposures or two months can be dangerous. After this much use a set of batteries may still test "good." In fact, under such a situation one photograph or two or three may be perfectly satisfactory. However, one more exposure may be just enough to cause the batteries to fail or drop below their needed power, resulting in a lost flash picture.

The main reason for this is a peculiar property of ordinary dry cell batteries. After having been out of action for a short time, a set of dry cells can increase in power until they are quite capable of operating a flash-gun, solenoid and bulb. However, a single tripping cycle can be enough to drop the batteries below their needed power. Thus, you may frequently encounter a customer who's cry of woe will be that he tested his batteries, went out and tried to make a series of pictures, only to find that the batteries failed after the second or third shot. He may even complain that later in the evening his camera again started to work satisfactorily. You see, even a short period of rest might be enough to rejuvinate the batteries. Warn your customer that the best insurance for consistant good results through a series of pictures is a set of brand new batteries. Batteries that have been used may be perfectly adequate for occasional shots made by an amateur. Even the amateur, however, occasionally tries to take several pictures in rapid sequence with a flash gun. This is the situation when battery failure most frequently shows itself.

LOOKING FOR TROUBLE

There are a number of points which should be highlighted in your inspection of equipment. Second only to battery troubles are those which arise from the various connectors and cords used in flash equipment. Wherever a connection is made, there is a possibility for resistance to build up. Examine all couplings, plugs, sockets and joints for signs of corrosion and similar defects.

Many photographers still believe in the old erroneous cliche ---- that wetting the base of the bulb will insure good contact when it is placed in the socket. This can be very true for a short time, since saliva is a good conductor of electricity. At the same time it is an excellent agent to start corrosion. Once corrosion begins in the flash bulb socket, resistance builds rapidly until the increasing resistance can cause flash bulb failure. To eliminate, or minimize, such trouble it is wise to suggest or even provide a simple abrasive pad, perhaps in the form of a disc of sand-paper cemented to the end of the battery case, so that the photographer can quickly and easily remove any corrosion from the base of the flash bulb and guarantee good contact.

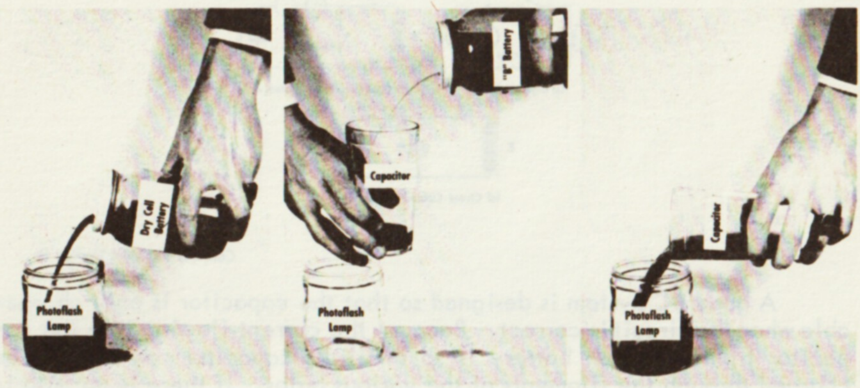
Fortunately, flashguns damaged by old, defective batteries are becoming less common. The occasion still arises when it is essential that you completely disassemble a flashgun, carefully clean all of the electrical parts and reassemble the equipment in order to eliminate flash failures.

There are still photographers who use ordinary flash light cells because of the apparent saving in cost. Good photoflash cells are slightly more expensive than ordinary flash light batteries but become virtually essential because of their increased power when dependable flash photography is to be carried on.

B. C. FLASH SYSTEMS

Professionals have very few problems with defective batteries because they constantly check and replace their batteries, knowing their shortcomings. With the great increase of amateur flash photography, however, flash failure gradually became more and more prevalent. The use of flash contacts rather than solenoid type synchronization makes the "battery-capacitor" system of flash photography virtually fool-proof and dependable.

Normally, the battery power of a flashgun is used directly in order to fire the bulb. This means that if the battery has decreased in power, flash failure is possible. The BC System guarantees a full, regulated amount of power available to flash bulbs dependably. Instead of a few cells being used to flash the bulbs directly, a battery, or batteries, are used to charge a capacitor. A capacitor holds a fixed amount of power. As the batteries age, more time may be required to charge the capacitor but the capacitor will still accept a maximum charge. When the shutter is tripped and the flash contacts are closed, the entire charge in the capacitor may be used to fire the bulbs.



Simulated Current Flow in Photoflash Systems — Courtesy National Carbon Co.

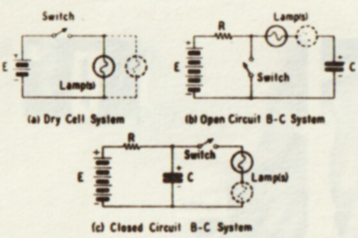
National Carbon Company has used a very clear and effective device to describe the action of a BC Flash System as compared with an ordinary dry cell system. The cell, or battery of cells may be compared to a bottle holding a certain amount of power that may be poured from the bottle at will. The ordinary dry cell is like a bottle with a moderately wide mouth, through which some of the contents may be poured in moderate quantity. The high voltage battery, such as is used in BC Systems, can be compared to a bottle with a relatively small mouth from which the power may be poured in only a trickle. The capacitor, on the other hand, may be compared to a glass or a bucket from which the contents may be dumped quickly and completely. Only so much power is available from the ordinary dry cell. It can be used only at a rate dependent on its internal resistance.

The high voltage battery has a much higher resistance, permitting you to use the power contained in it even more slowly. However, you can use the battery to fill the capacitor over a period of time. When ready

to use, the capacitor charge may be "dumped" through the flash bulbs, providing a very effective flashing current. When a dry cell ages, in effect, the neck of the bottle will become smaller and smaller so that it is more difficult to pour from it, or remove power from it. The capacitor remains constant in its ability to discharge and even though more time is required to fill it with power, you can still discharge it quite rapidly.

ADVANTAGES

Thus, the BC Flash System has many advantages. The higher voltage of the BC System means that resistance will have less effect on the amount of current that can be forced through the flash circuit. In order to guarantee that all flash bulbs being used (and it is possible to fire many flash bulbs on a BC circuit) will fire at once, all the bulbs may be wired in series, so that one surge of power from the capacitor is sufficient to fire all the flash bulbs in the string.



Courtesy National Carbon Co.

A good BC System is designed so that the capacitor is only chargeable when the circuit is correct. Because the current flowing into the capacitor from the flash battery is so small the capacitor can actually be charged through the filaments of the various bulbs. If there is no bulb in the circuit, or if the circuit is incomplete for any other reason, the capacitor will not charge and none of the bulbs will fire. A simple test lamp arrangement can be included in the design so that the operator can check to see that the capacitor has been in a charging condition before attempting to fire the bulbs by tripping the shutter.

CAUTION! Unless a BC System has been designed as a complete unit, some of these features may not be present. Thus, some BC "packs" can only be wired so that the capacitor remains in a charged condition. This system will not insure that all bulbs will be fired unless they are wired in series. The result is a tendancy for the BC flash battery to drain constantly if there is even a small amount of leakage in the capacitor.

The advantage of the BC flash unit can be utilized with any mechanical synchronizer or with built-in contacts. The surge of power that comes from a capacitor is not satisfactory for operating a solenoid. When a solenoid is tripped from a capacitor, the tripping action is so rapid that synchronization is very difficult. The BC System is ideally suited for amateur

use where the flashgun is used only occasionally. With a properly designed BC System, the battery may last as much as ten times as long as the cells in an ordinary flashgun. Couple with this the fact that the BC System will usually work either correctly or not at all and you have eliminated many flash failures. When the cells in an ordinary flash gun weaken, they may still fire the bulb or operate the solenoid or both, but, without dependability as to synchronization between the two.

WHEN TO MAKE CORRECTIONS

Having tested the flash synchronization set-up, as well as discussed with your customer his needs and method of operation, there is some question as to whether any adjustment should be made on the flash equipment. Fox

For example, it is possible that you would find the synchronizer adjusted so that the shutter opens at approximately 12 to 14 milliseconds after firing of the flash bulb. At first glance this might seem to be very poor and in need of adjustment. There are instances, however, when a peculiar flash synchronization adjustment has been made for a very specific purpose. If all of the light available from the flash bulb at a particular speed is desirable, such an adjustment might be quite ideal. Some professional photographers, for example, prefer to set up their permanent equipment, perhaps in the studio, so that a minimum aperture may be used at the moderate shutter speeds normally employed in the studio. Unless action photographs are to be made, it is well worth while to utilize as much of the light from a flash bulb as can possibly be gathered.

It is well for you to remember, then, that unless you know all the facts, no adjustment should be made to the synchronizer. Instead, simply report the results of your testing to your customer with as much clarity as possible.

These things should be taken into consideration:

1. How many flash bulbs are to be fired?
2. Will there be extensions used with the flash equipment?
3. Exactly what type of bulbs are to be used?
4. What type of photography is to be carried out with the equipment?

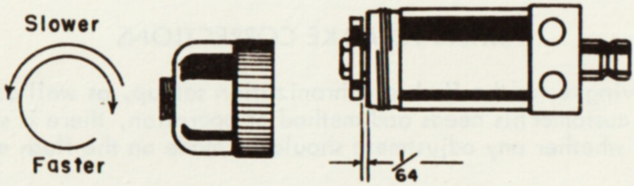
ADJUSTMENTS OF THE SOLENOID

Most solenoids have at least two adjustments, many have three. These adjustments might be roughly divided into two groups: Tripping position and delay.

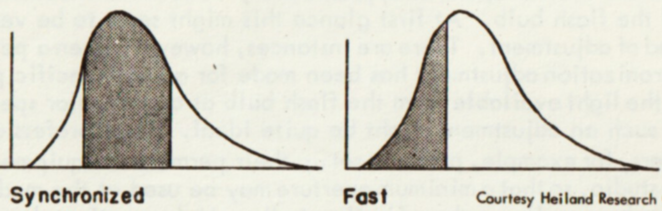
Solenoid-type synchronizers develop varying power during their tripping stroke. Maximum power is developed just as a solenoid or electromagnet completes its action. Since it is important that you get the maximum amount of power from the unit, the adjustment of the tripper should be such that that portion of the solenoid stroke developing the most power is used to trip the shutter. This is accomplished simply by matching the

movement of the tripper and the release lever of the shutter as precisely as possible.

With the Heiland type solenoid, the linkage between the armature and the shutter release lever is adjusted so that the shutter trips just before the armature reaches the end of its stroke. The adjustment is made as follows:



Curve of a typical flash lamp



Courtesy Heiland Research Co.

With the linkage in position, the Heiland Solenoid Cap is removed and the armature depressed by hand slowly. The shutter should trip when only 1/64 inch of armature travel remains. If the shutter does not trip even though the armature is depressed as far as it will go, the linkage between the solenoid and shutter release may be shortened slightly. If the shutter trips with more than 1/64 inch of travel remaining on the armature, the linkage between the solenoid and the shutter should be lengthened slightly.

With a Graflex-type solenoid, the problem is not quite as simple. This is true because the armature in the Graflex-type solenoid has a certain amount of overtravel that is not used when the solenoid is operated electrically. The technique for determining correct adjustment is as follows:

Very carefully and gently move the shutter release lever by hand. Move the shutter release only far enough to trip the shutter. When the shutter trips, stop moving the release lever and hold it steady. Still holding the release lever in that position, operate the Graflex-type solenoid with a battery case. If the position of the solenoid is correct, the release lever will move very little more, perhaps an additional 1/64 inch. If the adjustment is not correct, loosen the clamping bracket which holds the solenoid and slide up or down until the above conditions are met. If the shutter release lever does not move when the solenoid is operated electrically, it is necessary to move the solenoid down slightly (or away from the shutter release lever). If the shutter release lever moves more than 1/64 inch when the solenoid is operated electrically, the solenoid must be adjusted up.

In every case of position adjustment, it is wise to check the tripping action of the shutter electrically, using the battery case. Check once or twice to make certain that the position is accurate. Remember that the reason for accurate positioning of a solenoid is to gain the maximum power from the solenoid in tripping the shutter.

The position adjustment is made first and, once completed, assures that the solenoid will trip the shutter positively every time that it is operated. The only thing that remains is to adjust the length of the stroke of the solenoid armature in order to provide the proper amount of delay, i.e. 15 to 18 milliseconds. The longer the stroke of the solenoid armature the longer will be the delay. Under certain conditions you may discover that if the armature stroke is too long, insufficient power will be available from the solenoid to even trip the shutter.

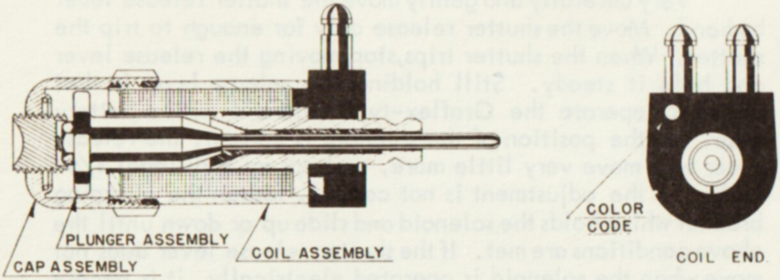
MATCH THE SOLENOID TO THE SHUTTER

If, after properly positioning the solenoid and adjusting the linkage, you find it impossible to obtain the proper delay, it is likely that the solenoid is not matched to the shutter. This means that the solenoid either does not develop enough power to trip the shutter or the solenoid develops too much power for that particular shutter. Such a problem will manifest itself as follows:

If, in attempting to increase the delay by lengthening the armature stroke, a point is reached where the shutter will not trip electrically, the indication is that a stronger solenoid is necessary. This means selecting a coil with heavier wire in it.

Color Code	D.C. Ohms. Resistance	A. W. G. Wire Gage	Wire turns	Force in Gms. in seated position
Tan	13.8	32	970	265
Blue	5.41	30	615	443
Green	3.11	29	408	523
Red	1.63	28	297	575
Orange	1.06	27	246	730
White	.86	26	227	760

Courtesy Heiland Research Co.



Courtesy Heiland Research Co

CAUTION! Do not make the mistake of assuming that the solenoid coil is too weak to trip the particular shutter without rechecking the condition of the batteries and other parts. It is possible that excessive testing can weaken the batteries to such an extent that they will no longer operate the solenoid satisfactorily. Remember that tripping the shutter repeatedly with a set of batteries can cause as much trouble in your test as it would cause the photographer making exposure after exposure with those batteries. At a time like this, it is wise to use the battery-like power supply built into your ServiShop Analyzer to trip the shutter repeatedly.

It is always wise to use the solenoid coil with the finest wire (greatest resistance) satisfactory to do the job. The reason? The heavier the wire and the lower the resistance, the greater the amount of current you will use to operate the solenoid and the heavier the battery drain. When you use a solenoid with maximum resistance, your user will be able to get the maximum life from each set of batteries.

In general, a shutter having a soft tripping stroke, like the Compur Shutter, requires a less powerful solenoid than a shutter having a harder tripping stroke. It is often worth while to free up the shutter's tripping action by internal adjustment. This permits you to use a solenoid that does not have high current-draining tendencies.

VARIETY IN INSTALLATIONS

The installation of various types of solenoids on particular cameras is dependent on many factors. The amount of space available for the inclusion of the solenoid is, naturally, most important. On the last pages of this lesson text are manufacturers' illustrations of installations on typical cameras of all types. There will, nevertheless, arise times when it will be necessary for you to plan and design your own installation for equipment that is unusual in one way or another.

Several points are worth remembering that will save you steps in special installations.

Probably the most important factor to consider is the clearances of any installation that you make. This means that one part of a camera may interfere with another after you install any kind of synchronizer. This

can become apparent when using a folding type camera in which the additional mechanism cannot be inclosed in the camera box when it is folded. Sometimes a solenoid installation will make it impossible to use a wide angle lens or other accessories normally employed with a camera. Beware also of possible interference with operating controls of the camera. For example, a poor choice of location for a solenoid installation might develop a difficulty for the operator in changing the diaphragm or shutter speed settings.

EASE OF ADJUSTMENT

Not only can it become difficult to adjust the camera but it can also become difficult to adjust the synchronizer itself if the position of installation is not carefully considered. In the case of the Heiland type solenoid, for example, make certain that the position in which the solenoid is installed will provide a maximum amount of adjustment in the linkage between the solenoid and the shutter release lever. Similarly, make sure that the movement of the solenoid as it trips the shutter will not interfere with other parts.

In the Heiland-type solenoid observe carefully the direction in which the release linkage pulls the release lever as the solenoid operates. For most efficient operation, the action of the solenoid should be as direct as possible, without forcing the solenoid to do any extra work. In other words, the movement of the solenoid linkage should be such as to pull the shutter release lever in a direction which will trip it most easily. Do not set the solenoid so that a sidewise pull is effected on the shutter release lever.

Select or build special linkage to suit the particular shutter and mounting being used. The shutter release lever and the solenoid linkage may not line up perfectly. In such instances special linkages are sometimes available although it is often wise to construct a simple linkage from hard brass wire that exactly suits the installation being made.

The Graflex type solenoid is also mounted so that its stroke is most effective on the shutter release lever. Binding between the linkage and the shutter can have a seriously adverse effect on dependable synchronization.

If there is an electrical connection that is made at the solenoid, make certain that it is easy to attach and remove without disturbing other parts of the camera. Make certain that a wire connected to the solenoid will not drape in any position where it can obstruct the lens or the view finder. Although a photographer can become accustomed to the fact that his view finder image is partially obstructed, a wire that passes in front of the lens is obviously unsuitable.

The illustrations will give you a variety of ideas as to the type of installations possible. Notice especially the methods which are used on cameras like the Rollei type to provide removeable solenoids. They permit closing of the camera case.

TESTING FLASH SYNCHRONIZATION

It is common practice to provide an extension of the release mechanism through the Rollei front housing in order to trip the shutter conveniently.

Those cameras having only a body release are best provided with a secondary release method in order to permit more direct synchronization with a solenoid. When you attempt to use a solenoid to operate a shutter through the normal camera linkage, so much power may be wasted that it becomes difficult, if not impossible to provide perfect synch.

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